# Safety Evaluation Report
# for Addendum to the
# Safety Analysis Report for Packaging for
# the Super Tiger Shipping Container
## Docket 07-30-6400

## December 6, 2007

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## Overview

This Safety Evaluation Report (SER) documents the review, performed by the Staff at the request of the U.S. Department of Energy (DOE), Packaging Certification Program (PCP), Safety Management and Operations (EM-60), on the *Addendum to the SARP for the Super Tiger Shipping Package*, Revision 0, RPT-460, dated December *2007* (the Addendum).[1] The Super Tiger Shipping Cask is certified by DOE Certificate of Compliance (CoC)[2] number USA/6400/B( )F (DOE), Rev 4. The safety analysis of the package is documented in the *Safety Analysis Report for Packaging Super Tiger Shipping Container as Adapted for LWBR Type Fuel Rods* (SARP).[3]

The DOE Office of Environmental Management (EM), is pursuing the disposition of 40 containers of Unirradiated Light Water Breeder Reactor (ULWBR) material. The ULWBR containers are currently stored within 20 dry wells of the Underground Fuel Storage Facility (UGFSF) at the Idaho Nuclear Technology and Engineering Center (INTEC). INTEC, formerly the Idaho Chemical Processing Plant, is located at the Idaho National Laboratory (INL). The ULWBR material is incompatible with INTEC chemical separation processes, so it was shipped to the INTEC for long-term storage. The proposed disposition for the ULWBR material is burial as low-level waste (LLW) at the Nevada Test Site (NTS).

The ULWBR material consists of unirradiated rods and miscellaneous unirradiated scrap pellets. Approximately 15,000 rods (and the miscellaneous scrap) are stored within 40 rod storage containers. The 40 rod storage containers, each weighing between 1400 to 2000 pounds, were transported to INTEC in a Super Tiger cask, USA/6400/B( )F.

The ULWBR material primarily consists of thorium and small quantities of uranium, mostly U-233. The bulk of the material exists as unirradiated rods constructed of ceramic oxide pellets within Zircaloy or stainless steel cladding. The ULWBR material within all 40 rod storage containers and the seed module has an overall weight of 14.2 metric tons and includes nuclear material consisting of 13.8 metric tons of thorium and 306 kilograms of uranium of which 301 kilograms is U-233.

The intention is to ship one to four rod storage containers at a time in the existing Super Tiger cask to the NTS for disposal. The CoC for the Super Tiger cask expires October 1, 2008. The cask will be fully loaded with last shipment of ULWBR material in four rod storage containers and disposed at the NTS.

This report documents the review of the Addendum. The Nuclear Regulatory Commission (NRC) had reviewed and approved *Safety Analysis Report for Packaging Super Tiger Shipping Container as Adapted for LWBR Type Fuel Rods* (SARP)[3] for the proposed contents and package in an earlier CoC. The Staff did not perform any confirmatory analysis on the NRC approved SARP bases. Based on the NRC review and approval of the SARP and the review of the statements and representations in the Addendum, the staff has concluded the design and performance of the Super Tiger with the intended payloads have been adequately demonstrated to meet the requirements of 10 CFR 71[4] and the International Atomic Energy Agency's Safety Standards Series No. TS-R-1.[5] The specific review for each SARP Chapter is documented herein.

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**Docket 07-30-6400**

## Chapter 1: General Information

This section of the Safety Evaluation Report (SER) covers the review of the General Information provided in Chapter 1 of the Addendum.[1] The applicant requests authorization to package and ship Uranium 233 oxide and thorium oxide in the form of intact LWBR-type fuel rods with the following deviations from the DOE CoC[2] and SARP[3]:

1. Note 9 on Drawing 32106, Sheet 1, Revision F[6] states "All welds per PPI QC DOC NO. W-13". Replace this note with: "All welding is to be performed per American Society of Mechanical Engineers (ASME) Section IX".

2. The 3-in. x 3-in. x 3-in. high efficiency particulate air (HEPA) filter installed on the inner door is considered part of the packaging design.

3. The Super Tiger cask drawings show 3/16-in. fillet welds attaching either an angle structural bar to the cask shell or the shell to an angle bar (Protective Packaging, Inc., Drawing 32106, Sheet 2, Section B-B[7]). Edge welds on the existing Super Tiger are single, 3/16-inch groove welds with a 3/16-in. angle bar backing. The existing welds are considered acceptable weld alternatives.

4. The inner door bolts shown on the Super Tiger Drawing 32106, Sheet 1, Revision F[6]are identified as ½-20 UNF bolts. The actual inner door bolts used on the Super Tiger are ½-13 UNC bolts. The internally threaded pieces in the inner door of the cask are also ½-13 UNC and were not re-tapped from ½-20 UNF.

5. Add the SARP[3] reviewed content of unirradiated LWBR fuel pellets in stainless steel tubes (rather than Zircaloy cladding) to the already approved unirradiated intact LWBR fuel rods in the DOE CoC, Rev 4[2].

6. The Operating, Inspection, and Maintenance Procedure for the Super Tiger Protective Overpack, Procedure No. CSK-003, Revision 0[8] identified in Revision 4 of the SARP is rewritten into Operating, Inspection, and Maintenance Requirements and Instruction for the Super Tiger Cask, PRD-340, Revision 0[9]. PRD-340 incorporates changes to the operating, inspection, and maintenance of the Super Tiger Cask to include:

   a. The use of a forklift in the loading and unloading of fuel rod containers is replaced with a rod storage handler.

   b. The tie-down cables identified in Procedure No. CSK-003[8] are replaced with chains for tie-down of the Super Tiger cask to the transport trailer.

   c. The inner door gasket will be replaced prior to first use during this shipping campaign and on an as-needed basis thereafter.

   d. The use of Heli-Coil® stainless steel thread repair inserts are allowed for the repair of damaged or unusable internal threads on the inner door closure.

   e. The 3-in. x 3-in. x 3-in. high efficiency particulate air (HEPA) filter installed on the inner door is considered part of the packaging design.

The Super Tiger Shipping Cask is certified by DOE Certificate of Compliance (CoC)[2] number USA/6400/B( )F, Rev 4 for the transportation of Type B materials. The safety analysis of the package is documented in the *Safety Analysis Report for Packaging Super Tiger Shipping Container as Adapted for LWBR Type Fuel Rods,* WAPD-LP(FE)-220, Revision 4, September 1985 [3].

Many shipments of have been made over the years with the Super Tiger package. The shipment of the ULWBR contents will be the last shipping campaign for the Super Tiger package. Justifications for the above deviations are included in the appropriate chapters of the Addendum[1].

Description of Contents

The Criticality Safety Index is 100 for shipments.

The Addendum[1] summarizes the proposed payloads as follows:

- The proposed payloads consist of a total of 40 rod storage containers. Thirty-eight containers are filled with already approved unirradiated intact LWBR-type fuel rods.
- Two containers are filled with the proposed content of unirradiated LWBR fuel pellets in stainless steel tubes. These are extra LWBR production pellets identical to the fuel pellets in the approved 38 rod storage containers.
- In addition to the fuel pellets, the two containers contain miscellaneous loose rods and fuel pellets consisting of breeder mockup rods (BMU) and detailed cell rods. The LWBR development program produced other materials that include: unused proof of breeding seed, blanket, power flattening, and reflector rods; defect rods; GRIP-II rods; production

irradiated fuel assay gauge (PIFAG) rod; 6-in. segments of rods; and loose LWBR pellets of all types. These contents are evaluated in Revision 4 of the SARP[3].

**Findings**

Based on the review of the information, statements, and representations in the Addendum, the Staff has concluded the General Information Chapter of the Addendum has been adequately described to meet the requirements of 10 CFR 71[4].

**Conditions of Approval**

Based on the review of the information, statements, and representations in the Addendum, the following conditions will be added to Revision 5 of the CoC[2] for approval of these contents:

The following limits and conditions apply to the proposed contents with respect to the existing CoC[2]. Revision 4 of the CoC[2] will revised as follows:

- Paragraph 5(b) of the CoC[2] will be revised to include the additional content of this shipping campaign. The additional contents consist stainless steel tubes containing unirradiated LWBR fuel pellets, various short fuel rods, and other miscellaneous LBWR related materials.
- Paragraph 5(d) will be revised to require that the inner door gasket be replaced prior to the first shipment under Revision 5 of the CoC and on an as-needed basis thereafter.

## Chapter 2: Structural Evaluation

This section covers the assessment of the Structural Evaluation information provided in Chapter 2 of the Addendum.[1]

**Findings**

The Addendum[1] contains adequate calculations and supporting information to demonstrate the packaging structural performance documented in Revision 4 of the SARP is valid for the existing ½-13 UNC closure bolts, the new ½-in. internal thread repair, and the alternate use of chains for tie-downs.

The applicant provided the Engineering Design File (EDF)-8407, Revision 0, Super Tiger Cask Weld Equivalency[10] calculations to support the alternate weld configuration. The PCP staff performed a confirmatory analysis, Calculation No. M-CLC-G-00372, Revision 0[11], to compare the 3/16-in. groove weld to the 3/16-in. fillet weld configuration. Both calculations supported the groove weld design as an acceptable alternative.

The Addendum[1] has demonstrated the Super Tiger Cask, has met all 10 CFR 71[4] requirements concerning structural design, material, fabrication, inspection, and testing. Therefore, based on the review of the statements and representations in the Addendum, the Staff has concluded the Super Tiger has been adequately described and demonstrated to meet the requirements of 10 CFR 71[4].

### Conditions of Approval

The Staff has concluded that no additional structurally-related conditions of approval need to be added to the CoC[2] for approval of this request.

## Chapter 3: Thermal Evaluation

This section covers the assessment of the Thermal Evaluation information provided in Chapter 3 of the Addendum[1].

### Findings

Based on the review of the information, statements, and representations in the Addendum, the Staff has concluded the thermal design of the Super Tiger Shipping Cask, as described in the Addendum, has been adequately described to meet the requirements of 10 CFR 71[4].

### Conditions of Approval

Based on the review of the statements and representations in the Addendum, the Staff has concluded the Super Tiger and the proposed contents has been adequately described to meet the requirements of 10 CFR 71[4]. The Staff has also concluded that no additional thermal-related conditions of approval need to be added to the existing CoC for the approval of this request.

## Chapter 4: Containment Evaluation

This section covers the assessment of the Containment Evaluation information provided in Chapter 4 of the Addendum[1].

### Findings

Chapter 4 of the Addendum[1] satisfactorily addresses the 3-in. x 3-in. x 3-in. HEPA filter located in the inner door of the cask.

Based on the review of the information, statements, and representations in the Addendum[1], the Staff has concluded the containment design of the Super Tiger Shipping Cask, as described in the Addendum[1], has been adequately described to meet the requirements of 10 CFR 71[4].

### Conditions of Approval

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded the Super Tiger and the proposed contents have been adequately described to meet the requirements of 10 CFR 71[4] based on the following revision to Revision 4 of the CoC[2]:

- Paragraph 5(d)(6) will be revised to require that the 3-in. x 3-in. x 3-in. HEPA filter be replaced prior to the first shipment under Revision 5 of the CoC and on an as-needed basis thereafter.

## Chapter 5: Shielding Evaluation

This section covers the assessment of the Shielding Evaluation information provided in Chapter 5 of the Addendum[1].

### Findings

Based on the review of the information, statements, and representations in the Addendum[1], the Staff has concluded the shielding design of the Super Tiger Shipping Cask, as described in the Addendum[1], has been adequately described to meet the requirements of 10 CFR 71[4].

### Conditions of Approval

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded the package design with the proposed payloads has been adequately described and evaluated to meet the external radiation requirements of 10 CFR 71[4]. The Staff has, therefore, concluded no additional shielding-related conditions of approval need to be added to the existing CoC[2] for the approval of this request.

## Chapter 6: Criticality Evaluation

This section covers the assessment of the Criticality Evaluation information provided in Chapter 6 of the Addendum[1].

### Findings

Based on the review of the information, statements, and representations in the Addendum, the Staff has concluded the criticality design of the Super Tiger Shipping Cask, as described in the Addendum[1], has been adequately described to meet the requirements of 10 CFR 71[4].

The Staff has concluded the Super Tiger Container with the proposed contents can be shipped with a CSI of 100.

### Conditions of Approval

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded the package design with the proposed payloads has been adequately described and evaluated to meet the criticality safety requirements of 10 CFR 71[4]. The Staff has, therefore, concluded no additional criticality-related conditions of approval need to be added to the existing CoC for the approval of this Addendum[1].

## Chapter 7: Operating Procedures Review

This section covers the assessment of the Operating Procedures information provided in Chapter 7 of the Addendum[1].

### Findings

The Operating, Inspection, and Maintenance Procedure for the Super Tiger Protective Overpack, Procedure No. CSK-003, Revision 0[8] identified in Revision 4 of the SARP[3] is rewritten into Operating, Inspection, and Maintenance Requirements and Instruction for the Super Tiger Cask, PRD-340, Revision 1[9]. PRD-340 incorporates changes to the operating, inspection, and maintenance of the Super Tiger Cask to include:

a. The use of a forklift in the loading and unloading of fuel rod containers is replaced with a rod storage handler.

b. The tie-down cables identified in Procedure No. CSK-003[8] are replaced with chains for tie-down of the Super Tiger cask to the transport trailer.

c. The inner door gasket will be replaced prior to first use during this shipping campaign and on an as-needed basis thereafter.

d. The use of Heli-Coil® stainless steel thread repair inserts are allowed for the repair of damaged or unusable internal threads on the inner door closure.

e. The 3 in. x 3 in. x 3 in. high efficiency particulate air (HEPA) filter installed on the inner door is considered part of the packaging design.

Based on the review of the statements and representations in the Addendum, the Staff has concluded that the Operating Procedures have been adequately described to meet the requirements of 10 CFR 71[4].

### Conditions of Approval

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded the package design with the proposed payloads has been adequately described and evaluated to meet the operating procedure requirements of 10 CFR 71[4] based on the following revision to Revision 4 of the CoC[2]:

- The conditions of Paragraph 5(d)(8) will be revised to reference PRD-340, Operating Inspection, and Maintenance Requirements and Instructions for the Super Tiger Cask, Revision 1[9], as the operating, inspection, and maintenance procedure instead of CSK-003[8].

## Chapter 8: Acceptance Tests and Maintenance Program Review

This section covers the assessment of the Acceptance Tests and Maintenance Program information provided in Chapter 8 of the Addendum[1].

### Findings

CSK-003[8], as discussed Chapter 7 Operating Procedures Review, also applies to the this Acceptance Tests and Maintenance Program Review Section.

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded that the Acceptance Tests and Maintenance Program for the shipping container have been adequately described to meet the requirements of 10 CFR 71[4]. The Acceptance Tests and Maintenance Program for the Super Tiger Shipping Container are addressed in the SARP[3].

### Conditions of Approval

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded the package design with the proposed payloads has been adequately described and evaluated to meet the Acceptance Tests and Maintenance Program requirements of 10 CFR 71[4] based on the same revision identified in Chapter 7, Operating Procedures Review, of this document.,

## Chapter 9: Quality Assurance Review

This section covers the assessment of the Quality Assurance information provided in Chapter 9 of the Addendum[1].

### Findings

Chapter 9 of the Addendum[1] supplements Revision 4 of the SARP[3]. Because the existing SARP[3] does not contain a Chapter 9, the current Addendum[1] Chapter 9 addresses this requirement.

Based on a review of the statements and representations in the Addendum[1], the Staff concludes that the Quality Assurance program has been adequately described, and meets the quality assurance requirements of Subpart H of 10 CFR 71[4]. Package-specific requirements are adequate to assure the package is designed, fabricated, assembled, tested, used, maintained, modified, and repaired in a manner consistent with its evaluation.

### Conditions of Approval

Based on the review of the statements and representations in the Addendum[1], the Staff has concluded that the quality assurance program for the Super Tiger Cask has been adequately described to meet the requirements of 10 CFR 71[4]. The Staff agrees, and therefore concludes, that no additional quality assurance-related conditions of approval need to be added to the existing CoC[2] for the approval of this request.

## References


[1] *Addendum to the SARP for the Super Tiger Shipping Package, RPT-460*, Revision 0, dated *November 2007* (?????).

[2] *U.S. Department of Energy Certificate of Compliance (CoC), USA/6400/B( ) F (DOE),* Revision 4, October 19, 2007.

[3] *Safety Analysis Report for Packaging Super Tiger Shipping Container as Adapted for LWBR Type Fuel Rods,* WAPD-LP(FE)-220, Revision 4, September 1985.

[4] Nuclear Regulatory Commission, *10 CFR Part 71, Compatibility with IAEA Transportation Standards (TS-R-1) and Other Transportation Safety Amendments; Final Rule*, 69 F.R. 3698, pp. 3698–3814, January 26, 2004, as amended.

[5] *IAEA Safety Requirements No. TS-R-1, Regulation for Safety Transport of Radioactive Material,* April 2005

[6] Protective Packaging, Inc., Drawing No. 32106, Super Tiger, Sheet 1, Revision F.

[7] Protective Packaging, Inc., Drawing No. 32106, Super Tiger, Sheet 2, Revision 0.

[8] US Ecology, Inc., Operating, Inspection, and Maintenance Procedure for the Super Tiger Protective Overpack, Procedure No. CSK 003, Revision 0

[9] Operating, Inspection, and Maintenance Requirements and Instruction for the Super Tiger Cask, PRD 340, Revision 1

[10] CH2M-WG Idaho, LLC, Engineering Design File (EDF)-8407, Super Tiger Cask Weld Equivalency, Revision 0, September 25, 2007

[11] Super Tiger Cask Alternate Weld Design Analysis, Calculation No. M CLC G 00372, Revision 0, October 10. 2007.